# Ethics of Health Intervention Strategies on Musculoskeletal Disorders and Public Health


Student Researcher: Noureddin Chahrour

Faculty Supervisor: Dr. Margaret MacNeill

Faculty of Kinesiology and Physical Education at the University of Toronto

# Abstract

Background: Musculoskeletal disorder are becoming an increasing burden and is costing the health care system in the US and Canada billions of dollars annually(McGee, 2007). Blangsted et al., (2008) found that self-reported neck pain in office workers was 45.5% in the past 12 months and 18.1% continuous pain. Health apps for smartphones are being used as an intervention to MSDs and maintain general health. Wearable technology is also being incorporated with sensors to allow individuals to assess their general health.

Purpose: To examine the ethics and effectiveness of different health communication strategies to prevent or cope with MSD's and general health practices.

Methodology: A variety of different communication strategies such as physical, social, and ergonomic factors were depicted. A key word search of the literature was conducted using Medline, PubMed and the University of Toronto Gerstein Library databases. Some articles in the grey literature will also be examined explore some new trends in health communication. Articles that were deemed relevant to the research topic were included initially based on the abstract. The researcher would systematically read each article to determine its relevance to the topic further.

Findings: Health and wellness social media applications (apps) are the number one apps that are being downloaded by mobile users(Kobayashi, 2014). As a consequence some of the apps are infiltrating the users privacy and outsourcing personal information to third parties. Posture braces to help relief neck and shoulder pain has been looked at as an alternative and many studies indicate that muscle stress is taken away from muscles like the upper trapezius muscle from wearing a posture brace. Work Station designs for ergonomic interventions in office workers showed positive findings in reducing neck pain(Rempel, Krause, Goldberg, Benner, Hudes, Goldner, 2006) however redesigning work stations can cost a lot.

Conclusions: Health app development should be more regulated as an industry by organizations such as the FDA and OHSA. People should be more health cautious when downloading health apps and reading the fine print before downloading them. Wearable technology such as posture braces should be studied more extensively as it is a promising area of research to help prevent or cope with the burdens of MSDs. More research needs to be conducted on the different intervention strategies.

---

Keywords: Social media applications, privacy, posture braces, musculoskeletal disorders, wearable technology, ergonomics, ethics.

# Methodology

A variety of different communication strategies such as physical, social, and ergonomic factors were depicted. A key word search of the literature was conducted using Medline, PubMed and the University of Toronto Gerstein Library databases. Articles that were in the range of 2007 and over were deemed as appropriate for the app ethics as most app research was not until 2009. Some articles in the grey literature will also be examined to explore some new trends in health communication. Articles that were deemed relevant to the research topic were included initially based on the abstract. The researcher would systematically read each article to determine its relevance to the topic further.

## *Ergonomic Workstations Controversy and Politics*

Musculoskeletal disorders or (MSD) are forms of injuries affecting connective tissue such as muscles, nerves, joints, cartilage and spinal discs (Bureau of Labor Statistics, 2008). These injuries may occur when muscles or tendons are either over-used or stretched past their capabilities. Ergonomic risk factors such as repetitive motion, awkward posture, forceful exertions, pressure points, and static postures can cause or worsen MSD (NIOSH, 2007). Repetitive strain injury (such as carpal tunnel syndrome , and tendinitis) of the wrist and arm have risen by 80% since 1990 according to the US bureau of Statistics, and are now the single most cause of work related injury. This is being described as the epidemic of the nineties. In the US alone, more than 600,000 workers have MSD resulting in days away from work each year (Bureau of Labor Statistics, U.S. Department of Labor, (2001). MSDs impact Canadian society by costing the health care system $20 billion (McGee, 2007).

Ergonomics is of high importance to preventing and or coping with musculoskeletaldisorders and in November 1999, the Occupational Safety and Health Administration (OSHA) published a proposed ergonomic standard for businesses and thus has been a source of debate since. The National Coalition on Ergonomics (NCE), and the National Federation of Independent Business (NFIB) spoke out against this standard and questioned whether repetitive stress injuries (RSIs) or musculoskeletaldisorders were caused by poor design in workstations and the expenses that would be paid to replace such workstations.These standards are said to protect more than 100 million people in America that suffer from work related injuries whether it is a job-from assembly lines to computer work stations (Young, 2000).

The OSHA estimates that 1.8 million workers have MSD injuries related to ergonomic factors and a third of them miss work each year due to MSD injuries. It is claimed that the rules to abide by the standard would cost $4.5 billion to implement and reap $9 billion in savings from medical to work compensations (Young, 2000). However another study puts the cost to businesses as high as $90 billion, 10 times of that estimated savings and this is stirring controversy between business leaders and implementation of these ergonomic standards (Young, 2000). For this reason a more cost effective measure needs to be taken that is beneficial for all.  Looking into new measures such as social media or smart phone applications and the buzz of health/ wellness apps is a new area of research that has not yet closely studied.

## *Social Media & Health Apps*

In the past two decades, the popularity of both social media and social applications has grown exponentially and has emerged into areas such as healthcare. The term social media includes applications of online software tools including social networking sites such as Facebook, MySpace, and Twitter. Internet-based tools are said to help users to connect, collaborate, and communicate with others more effectively. In June 2009, the Apple App Store offered 50,000 apps; today there is well over 1 million apps available most can be downloaded from the Google play store.Health and fitness apps on smart phones are ranked as the highest downloaded apps in today's market (Kobayashi, 2014). Many critics see that there is a problem with social media especially when using your smart phone device as a mean of recording personal information. Some of these health Apps are taking users' personal information and selling it to corporations that exploit it to generate their demographics for business profit without the users consent. This issue is an ethical dilemma as such practices go against fundamental values of privacy and human agency and the right to know what is being done with user's personal information. Privacy invasion should be of high importance to political agendas as it affects each and every single citizen that carries a smart phone which is about 70% of all mobile device users in Canada (Kobayashi, 2014). It's relevant both ethically and legally as it is a fairly new emerging ethical dilemma that does not have much regulations nor laws to prevent such app makers from exploiting and selling app users personal information to third parties. The terms of the privacy policy are vague and some app developers do not provide a privacy policy to begin with. App user is signing off all personal information such as address, financial info, full name, health information, geo-location, email, first name, friends, interests, weight, and potentially embarrassing/sensitive info (Kobayashi,

2014). Therefore the public needs to be aware of what these app developers are doing and the government should implement laws and regulations against privacy invasion by app developers and third parties.

Personal information should be treated as confidential as health information. It would be unjustifiable for a health care professional to release medical records and sensitive health information of a patient. Laws and regulations prohibit health care professionals to do so. Therefore app developers that are collecting such personal information including health parameters should only use that information for the sole purpose of the app that the user is using it for.

## *Use of Social Media in Nursing Practices*

With increased usage within the discipline of nursing, global nursing organizations have begun to provide guidelines for the responsible use of social media in the profession. The regulatory National Council of State Boards of Nursing (NCSBN) has published several brochures pertaining to the usage of social media in nursing. Orders for these brochures have also come from regulatory agencies and nurses from Canada, the Philippines, and Europe (Spector & Kappel, 2012). Evidently, global nurse regulators and leaders of nursing are interested in developing acceptable practice with social media.

Individuals who seek healthcare services and information regularly search online for medical information. As members of a healthcare discipline that seeks to serve mankind in ways that

honor human dignity, nurses have an ethical obligation to consider the opportunities and limitations for using social media.

Members within the healthcare disciplines, including the discipline of nursing, are increasingly using social media in practice, research, as well as in their personal lives. There are many common paradoxes that may be witnessed as the healthcare disciplines grapple with what is morally right and wrong. First, there are illusions of personal privacy, while potentially violating others' confidentiality. It is becoming increasingly alarming to read about professional nurses using Twitter and Facebook to discuss and provide information about their patients. Participating in such actions violates the nurse-person, nurse-family, nurse-colleague, and nurse-community relationships as there is limited privacy when using social media. Violating such personal relationships provides pathways to possible litigation as well as the loss of societal trust in the discipline of nursing.

## *Physicians and Health Apps*

Surveys show that 90% of physicians use smartphones or tablets in their day-to-day professional activities(Boruff, Storie, 2014).Scher (2015) states that patient/physician relationship can be improved by promoting shared health management; connecting patients with peer and support communities online to more actively engage them in their own care; assisting caregivers in following physicians instructions; and providing useful patient data to both the patient and the physician who may be monitoring uncontrolled chronic conditions (Scher, 2013). A recent study found that one third of physicians have already recommended an app to a patient for such

reasons as these (Hussain, 2015). This leaves the other two thirds not recommending these health apps and the reason for that is most of these health apps are not regulated by the FDA (Gauntlett, MacCarthy, Tindall et al., 2013).

Many medical apps are providing false information to patients and physicians. For example, an app that measures blood pressure was assessed by an emergency physician and found that it gave inaccurate readings. The app developers were contacted by the doctor and the app developers mentioned that the app is still in beta testing and it is not intended for real health data but rather for entertainment purposes only. However looking at the consent policy section none of this was found in the app description and is currently being sold in app stores (Hussain, 2013).

In 2013, the FDA came out with regulations and rulings of what apps are deemed appropriate as health apps and published its ruling (US Food and Drug Administration, 2014). The document states that "Only apps that serve as medical devices or transform a device into a medical device or perform patient-specific analysis and then provide a diagnosis or treatment on the basis of it will be regulated" (Scher, 2015).

Therefore an app that can include an app/device combination and transforms a smartphone into an ECG recorder would be FDA approved. Other examples include but are not limited to combinations of smartphone and ultrasonography machine, blood pressure cuff, or pulse oximeter.

The Health Insurance Portability and Accountability Act (HIPAA) protection comes from both how information is handled by the app itself (which is the responsibility of app developers), as well as security measures, such as using strong passwords for our devices (which is the responsibility of hospitals and physicians).

However security and privacy is still an issue for most of these health apps and the use of them will be limited by physicians. The federal government has said that it will better define the HIPAA standards to make sure that mobile app developers can comply with these standards (Burwell, 2014).

WellDoc in Baltimore, Maryland, is a company that uses mobile technology to improve disease management outcomes, and has developed Bluestar® which is a product of this company. The FDA cleared this app and it is the first app to be used by adults with diabetes. Doctors are reimbursed by commercial health plans when they use it to monitor their diabetic patients (Moukheiber, 2014).

## *App Privacy and Confidentially*

Common myth relates to a lack of responsibility and accountability for what one posts and enters into a social media platform. Many individuals falsely assume that what is deleted on a website, or instant messaging plat-form is gone. This is not the case, as all words are retrievable and have been used as evidence in legal cases. Members of healthcare disciplines, such as nurses, are responsible and should be held accountable for their words and online posts about previous or current patients. Articulating one's health situation in an online platform has major consequences both ethically and legally.

Heidegger (1977) states that as human beings we have become too reliant on technology that it is controlling our day to day lives. Furthermore, the practice of allowing an individual to be reliant on an app rather than a health care professional is risky in the sense that laws and

regulations do not prohibit app users in making your personal information public. This has benefited app developers and third parties that find this personal information valuable for their marketing demographic.

The Privacy Rights Clearinghouse(2013) decided to look at the information practices of the broad heading of health and fitness mobile apps in which the sensitivity of personal information is particularly significant. In collaboration with the California Consumer Protection Foundation they analyzed 43 health and fitness apps (23 free and 20 paid) on the Apple iOS and Android platforms, to highlight the major consumer privacy risks. Below is a table that indicates the difference between the paid vs. free apps and the privacy issues with each.

| | Free apps | Paid apps |
|---|---|---|
| **App has link to website privacy policy** | 43% | 25% |
| **Notifies user that privacy policy does not apply to 3rd party links** | 48% | 25% |
| **Notifies user that personal information made public is not protected** | 57% | 15% |
| **Shares user-generated PII data with advertisers** | 43% | 5% |
| **Shares aggregate (non-PII) data with marketers** | 52% | 55% |
| **Uses anonymized (non-PII) data for analytics** | 70% | 70% |
| **Contact info: developer's email address listed in policy** | 57% | 100% |
| **Can opt out of developer/vendor sharing data with 3rdparties** | 57% | 30% |
| **Can opt in to data sharing with 3rd parties** | 35% | 30% |

The technical analysis assigned risk levels to the applications tested based on the amount of personal information they collected, along with our judgment as to the sensitivity of that information. They assigned risk based on the criteria below, on a scale of 0-9. For the sake of convenience, this numerical rating scale was converted to “high,” “medium,” “low,” “none”:

- High risk (7-9)—includes address, financial info, full name, health information, geo-location, date of birth (DOB), ZIP code
- Medium risk (4-6)—enhanced privacy risk to PII; email, first name, friends, interests, weight, potentially embarrassing/sensitive info
- Low risk (1-3) —moderately low risk; anonymous tracking, device information, a third party knows the individual is using a mobile medical app
- No risk (0) — no PII or health-related information

Based on these criteria, they determined the following:

- 40% of the apps were high risk (17 of the 43 apps)
- 32% of the apps (14 of 43) were medium to high risk
- 28% of the apps (12 of 43) were low to medium risk
- none of the apps were evaluated to be no risk

(Privacy Rights Clearinghouse, 2013)

Therefore, a total of 72% of all apps whether free or paid are above medium to high risk(Privacy Rights Clearinghouse, 2013). The app developers and third parties that are taking advantage of this personal information are privileged as they can make profit by advertising

their products to the consumers of the app and therefore drive sales of their products. On the other hand, app users may be unprivileged in the sense that their personal information can be leaked or outsourced to third parties. Therefore, one has to question the motives of app developers. There is also the risk of sensitive information not being affiliated with third parties but being transferred over unsecured plaintext HTTP such as "Kevin did not take his HIV medication please push reminder" and therefore can make it accessible for anyone within the range of Wi-Fi signal to detect such messages (Kobayashi, 2014). Therefore, the app users freedom and agency is silenced, he/she is only seen as a commodity for making profit.

The impact of such discourses is that many app developers do not provide a consent policy or if they do it is usually very vague and does not indicate that they can outsource your information. Taylor(2009) says, “we have moral obligations to help just as we do not to harm". However one can question whether the app developers of such health apps have the moral of helping the app user or the third parties interested in the app users personal information. Most of the time users do not even go through the consent policy even if the app developers provide it, as they are unaware of what the consent form actually entails or simply do not care to read it.

## *Giant Corporation Affiliation to Health Apps*

Health insurance and pharmaceuticals are always trying to learn more and communicate with their clients and many social media developers are consolidating with these companies. However this has serious implications for consumers. Someone's health can be willingly shared on social

media in order to track information such as diet and thus this can now be seen y third parties or insurance companies and set policy premiums on that individual.

Many of these social media companies say that they do not sell personal information about their users and that any user information that is transmitted is not personally identifiable. They argue that the information is used to improve their own social media applications. However medical information that is shared directly between a patient and their doctor is covered by the privacy provisions of the Health Insurance Portability and Accountability Act. There is very little regulatory protection for health information shared over social media. In most cases, "You're on your own with these commercially available apps," said Joseph Lorenzo Hall, a senior staff technologist who works on health privacy issues at the Center for Democracy and Technology. App users cannot assume that their data is private in the mobile apps or social media.

Capitalistic governments want to help app businesses grow and encourage entrepreneurship but at the same time this should be regulated in terms of what are acceptable, ethical and legal. There should be a resistance for what is best for the citizens and not just seeing people as consumers to a market capital, but respect their privacy and put legislation and laws/regulations in place to protect its citizens.

A mobile health app for women called baby center that tracks there pregnancy and allows them to know when they may deliver their baby is of growing demand to women. Dembosky (2013) mentions that this app is of great interest to big corporations like Johnson & Johnson or Procter & Gamble in which sell a lot of baby products and advertise their products on these apps. Women enter all kinds of personal information about their weight, diet, daily habits that these corporations have access to and can use that information to solicit their products (Dembosky,

2013). Many apps for women have been developed some to even track women's menstrual cycle."Data about women's reproductive health is particularly sensitive because of the negative ways people have used it," said Deven McGraw, director of the health privacy project at the Center for Democracy and Technology. Many other companies have also showed interest in these app such as car companies, property agents, and financial and insurance industry executives, as they recognize that pregnant women most often plan for the future of their family and consider many purchases and investments for the first time (Dembosky, 2013).

The act of neoliberalism and making citizens responsible for their own health rather than the responsibility of the society they live in. One of the problems with neoliberalism and involving the individual to take care of their own health is unjust in the sense that these individuals only have so much control over how society shapes their lives. Just take a look at what the Western society is dominated by in terms of the fast food restaurants, screen time per day, technology we are surrounded by and held victim to.

Technology is very aggressive and people have become resources for science and technology we consume their products sometimes without even knowing (Heidegger, 1977). An ethico-political stance by the governments in each country can be taken to prohibit app developers from selling app users personal information. Also, laws on software and firewall protection to not allow for anyone to intrude on app users personal information needs to be implemented. Foucault's metaethical frame work one can derive solutions to such a problem from different perspectives. An intellectual ethic of conducting more research in the field of bioethics and app privacy, a political ethic of speaking out and having governments take action to ensure app user privacy. Finally, a relationship ethic by working with app developers and ensuring lawful and ethical conduct is being practiced with app user personal information.

## *Prevention of personal information breaching to third parties*

There is a power imbalance between the app developers and app users and as Ronell discusses the severity of problems that can arise because of the dominating nature of mankind (Taylor, 2009). From a social perspective, educational tech campaigns can help people be more self-aware of what the privacy policy of an app entails. This needs to be of high priority as it is culturally accepted to provide consent to app developer's privacy policy. Laws and regulations should also make it clear that it is strictly prohibited and against the law to sell/outsource the app users personal information to any third party unless it is intended for the sole purpose of the app.

Apple is looking into making the privacy rules stricter in the App Store and restrict peoples data from being outsourced in health and fitness apps as this is a growing concern for how Iphone users personal information is being treated.

The new Healthkit platform developed by Apple will allow users to track health data such as exercise, sleep, diet, heart rate, etc. The App Store has a new set of rules and states that app developers must not sell app user health information that is collected through its Healthkit platform to advertising data brokers or information resellers.

Apple is making these privacy settings to differentiate from its rival Google and the Play Store in which relies heavily on advertisements for its main source of income. The Healthkit platform will allows app developers to contribute data from their own apps and grant permission to users.

Any app developers that want to get into the HealthKit's app programming interface (API) must link to a privacy policy with a new set of rules.

Any app that is through the HealthKit must not use any API for any purpose other then providing health and or fitness services. All apps must have a privacy policy and any app that breaks the rules wil risk the expulsion from the app store. Any breach of the privacy policy may involve legal enforcement. In January, Apple executives discussed "medical applications" with the US Food and Drug Administration.

"HealthKit is aggregating data from what will likely be multiple sources within one location on the device," says Geoff Blaber, an analyst at CCS Insight. "Apple is being very careful as to how that is utilised or controlled. It's Apple tightening control on developers."

The new iOS 8 update for iPhones will include several other new privacy features. For example new ways to block cookies in its Safari web browser, and end-to-end encryption of iMessages.

"Apple faces this increasingly tricky balance of ensuring they are carefully regulating the data developers have access to, with developers' desire to create ever more innovative apps and services," Mr Blaber said. "Apple has always closely controlled what comes through the App Store, far more so than Google."

People have become dependent on technology and it would be extremely challenging to change their lifestyle of not using health apps. However one can argue that free citizens must know what is being done with our personal information and not accept that it is used as a commodity for profit. Taylor(2009) states that courageous acts by groups of people can serve to transform human nature and in turn provide us with the capability toward moving to a more equitable democracy. But in order for this democracy to be implemented, citizens need to put pressure and demand the government to put out such laws to protect them. This can be done in

the form of calling and writing letters to a Privacy Commissioner. The Privacy Commissioner is an Officer of Parliament, reporting directly to Parliament about how organizations handle people's personal information and putting pressure on parliament to make such changes and laws. Education campaigns can be in the form of raising awareness to help people better understand what kind of personal information they share and think twice before providing any kind of information. As well demand app developers to avoid fine print in privacy policies and make the privacy policy easy for someone like my mother or grandmother to read and understand.

It is crucial that laws and regulations be passed about what is being shared and what kind of personal information is being collected by app developers as technology is extremely advancing and once something is made public there is no taking it down like the internet. For this reason any private/personal or embarrassing information should be collected and stored with very high security so that it does not breach to the public. If governments can learn one thing from the internet and World Wide Web is that once something grows too big and out of hand it is harder to control. Smart phones are growing at a very high rate and health apps are the number one apps being downloaded by app users, it is still a new concept and therefore laws and security is something of high importance for the general public.

## *Wearable Technology as a Health Intervention*

As the field of digital health swiftly expands, so do all its niches, including that of wearable health devices. While the concept of wearable devices that collect data is not a novel one, it is now being revolutionized to include biosensors that collect more data that is more accurate and valuable. Next wave/ future generation of wearable technology will allow the gathering of data that we could not previously gather outside of a lab setting while being barely detectable. The goal of these new wearable health technologies is to maximize on precision, predictability, and prevention while minimizing the size, visibility, and hassle of use to be, for example, as miniscule as a fiber that could be attached to clothing. The data collected through these devices will prove to be useful to patients, their doctors and research trials in the emerging field of precision medicine, a rapidly evolving field that aims to incorporate a variety of research data such as molecular, population, and clinical research to create defined, preventative and liable treatments. These wearable technologies will allow patients to obtain more meticulous and exact data and therefore, through collaboration with their clinicians and clinical trials, maintain good health and wellbeing and effectively manage illness and disease while devising new treatments.

An example of this is the smart garment developed to reduce kyphosis during daily living (Edmond Lou, et al, 2012). This garment was designed to treat postural kyphosis, a flexible spinal deformity which is defined as the smooth rounding of the back in the sagittal plane upon forward bending that is the product of poor posture (Lovell, et al. 2006)). Unlike pathogenic kyphosis, such as that produced by a misshaped vertebrae, the postural kyphosis can be entirely corrected and proper posture can be completely restored with active extension of the back muscles by the willing individual. While the cosmetic or appeal of the poor posture is the most

concerning aspect to many studies have shown that the implication are adverse and far reaching. Now we know that postural kyphosis hinders physical and respiratory function and plays a role in neurological problems and most importantly leads to back pain (Macagno & O'Brien, 2006). Sustaining an improper posture for long periods of time leads to deformities of the spinal discs as a result of increased spinal loading and increased biomechanical stress on the vertebrae. The projection or rupture of the vertebral discs leads to back pain through compressions against spinal nerves, and the biomechanical stress may lead to wedge shaped vertebrae that could further worsen the kyphotic curve and lead to a positive feedback cycle that results in an increasingly intensifying the postural kyphosis and poor posture.

Studies have suggested that those suffering from spinal aches and back pain in adult or older years oftentimes had poor postural habits during their developmental and adolescent years that led to poor development of their spine (Sinett, 2008). Hence, this suggests that a preventative measure during those developmental years is key to preventing and reducing spinal pains and aches later on in life.

With the unfolding of the technology age and the introduction of smart phones, tablets and computer related activity, the sedentary lifestyle with poor posture became inevitable. Bad posture habits are being fostered at such a young age and becoming harder and harder to reverse. There are many treatments available to patients with poor posture and postural kyphosis, but the most common are; exercise therapy and braces. Exercise therapy is prescribed to children with mild postural deformities to increase spinal flexibility and strengthen back muscles (Wong, 2008), while the braces however provide a greater affect by creating awareness through passive pulling away from improper/ uncomfortable posture and pressure points in the brace. Through

this the patients becomes more aware of their poor posture and actively engage in proper posture through the use of muscles to create trunk alignment (Bazzarelli, et al. 2001; Dworkin, et al.1985) . Despite the general understanding of the negative consequences of poor posture in early years on future health, medical intervention and treatment are rarely seen as necessary. Even when these treatments are prescribed to children or teenagers, the compliance with the treatments is still the number one cause of its failure. While there are many reasons for lack of commitment to the treatment the number one cause is believed to be comfort, bulkiness and the accumulating of unwanted attention which negatively affects adolescence going through the character building and sensitive stages in their lives. As a result of these challenges an emphasis on the engineering of a smart garment that is more effective but less visible/ noticeable for posture correction. The emphasis has also shifted towards empowering the patients to take an active role in their treatment and body function by providing them with more accurate and extensive data that helps them become more aware of their body function, including posture, and encouraging them to make active choices to fix them ( Davis, 2009).

In their study Edmond Lou et al, (2012) demonstrated the effectiveness of such smart garment in treating poor posture and postural kyphosis. The smart garment consisted of a harness- like device that is put over the arms like a backpack with adjustable shoulder straps and waist straps securing the harness, and two data sensors in plastic boxes attached to the harness with Velcro.

Participants were asked to wear the garment for three hours a day on four consecutive days. The garment was to monitor posture and provide vibration to wearer when improper posture was sensed during daily activities. Laboratory tests demonstrated that the garment was able to reduce the kyphosis and improve posture in the short term. The garment reduced the kyphotic angle by

8± 1 on the 3rd day and 8±2 on the fourth day. Long terms effects however, are still unclear and very poorly explored.

## *Posture Braces*

A study by Cole et al (2013) assessed forward-head, rounded-shoulder posture (FHRSP) which is a postural anomaly that plays a role in shoulder pain and pathologic conditions. Forward-head and rounded-shoulders are both postures characterized as excessive anterior orientation of the head and glenohumeral joint relative to the vertical plumb line of the body (Lewis, Green, Wright, 2005). These postural symptoms are associated with overuse injuries to the shoulder (Fu, Harner, & Klein, 1991). In today's society most people complete tasks that are shoulder dominant and are performed in static postures such as driving or working on a computer work station. Research indicates that FHRSP causes tissue overuse, injury and pain due to altered scapular mechanics and muscular activity around the shoulder complex. Patients may exhibit greater anterior tilt and upward rotation of the scapula during flexion motions at the shoulder if they have FHRSP. Both of these specific scapular positions are related to shoulder conditions, suggesting that head and shoulder posture might influence the development and progression of overuse injuries (Michener, McClure & Karduna, 2003).

Electromyographic (EMG) activity may be different in people with altered position scapula and glenohumeral joint as a result FHRSP therefore this may lead to overload and injury. People with FHRSP that overuse their shoulders display decreased serratus anterior and lower trapezius activity during shoulder motions (Thigpen, Padua, Michener et al., 2010). Many researchers believe this may be the cause in pain as a result of disrupted force couples surrounding the

scapulas. Researcher also measure activity of the upper trapezius muscle to assess whether posture may affect the development of overuse injury in people with forward head and rounded shoulders (Cools, Witvrouw, Danneels, Cambier, 2002).

Health care professionals recommend the use of bracing or taping the scapulothorcic articulation to restore normal posture and muscle activity around the scapula. Scapular taping technique involves retracting and depressing the scapulas and applying tape over the scapular spine and medial boarder (Selkowitz, Chaney, Stuckey & Vlad, 2003) . Individuals experienced a decrease in upper trapezius muscle activity and decreased pain as a result of taping (Hsu, Chen, Lin, Wang & Shih, 2009). The only problem with the taping method is that it may irritate the skin and may not be feasible to do daily or for prolonged use. Therefore, a product like the Posture Performance Shirt can be used to improve scapular positioning and muscle activity to cope with neck and shoulder pain. Its scientifically engineered to reposition the shoulder in the retracted position and improve muscle activity and movement.

A study conducted by Walther et al (2004) compared a group of participants with subacromial impingement syndrome one took a functional brace with traditionalrehabilitation and the second was a home-based program. The same improvements in shoulder pain and function were seen after 6 and 12 weeks of both rehab groups. Walther et al (2004) suggests that the bracing might be as effective as traditional methods for treating impingement syndrome. Thus, bracing technique may be used as a tool to help correct scapular position and treat pain in individuals with shoulder pain.

## *Performance Aspect of Posture Performance Shirt*

Athletic trainers may use bracing or taping to correct an exercise program or perhaps restore more length tension relationships in muscle throughout exercise. Only one study has assessed performance of overhead athletes while using bracing or taping on the shoulder girdle.

Cole et al (2013) study was to determine whether a commercially available shoulder brace could improve posture and muscle activity of the scapular stabilizers in overhead athletes with FHRSP. There results suggest that the brace changes FSA and alters some muscular activity during activity. Changes in posture were seen in FSA and the EMG amplitude was found regardless of the tension of the straps. This suggests that the brace had both a mechanical alteration on joint alignment and a proprioceptive feedback from the brain. However the EMG results were not conclusive and should be taken out of context.

Cole et al, (2013) studied FSA as it decreased when participants were wearing the brace compared with when they were not wearing the brace. The potential for taping or bracing to change FSA posture has been demonstrated using tape application to the skin surrounding the scapula. Lewis et al (2001) found that scapular taping decreased FSA which were similar to Cole et al (2013) study. These findings suggest that shoulder posture can be changed in short term while wearing the posture brace. Ulkar, Kunduracioglu, Cetin, Guner (2004) suggest that both active and passive joint repositioning sense with the application of the brace had enhanced proprioception and cutaneous feedback that the brace offered.

Scapular stabilizing brace appears to have caused a positive change in FSA and EMG amplitude of muscles like the upper trapezius and the lower trapezius (Cole et al, 2013). However more participants need to be recruited as the sample size was too small and thus they make no definitive recommendations based on this single study. However the accumulating body of research and literature does suggest some benefit of using braces and taping techniques with people who are at risk of poor posture. Miller & Osmotherly (2009) mention that scapular taping and bracing does assist in recovery after impingement syndrome and after rehab.

## *Conclusion*

Health apps are a great way for people to track their health however one should always do their own research on the app and consider if it is safe to download as well as whether it is giving reliable information. Having the FDA and other organizations as well as laws/ regulations as Apple did with its HealthKit Platform is a step forward in the right direction. App users should also be aware of what the information they are giving up on the app is going to be used for. Finally having a combination of technology and wearable clothing is the next step forward in health care as we can see with many clothing manufacturers are doing this and building sensors seamlessly into clothing fibers. Posture braces as a wearable technology is an advancement especially in the scope of MSD's and should be considered to have more research on as it has shown significant improvements in shoulder stability and posture.

# *References*


Bazzarelli, M, Durdle N, Lou E, Raso J (2001) A low powerportable electromagnetic posture monitoring system. Proceedingsof the 18th IEEE Instrumentation and Measurement TechnologyConference 1:619–623

Bureau of Labor Statistics. (2008). Nonfatal occupational injuries and illnesses requiring days away from work, 2007. Washington, D.C., U.S. Department of Labor, Retrieved on March 1, 2009

Bureau of Labor Statistics, U.S. Department of Labor, (2001). Lost-work time injuries and illnesses: characteristics and resulting days away from work. Available from: http://www.bls.gov/iif/oshwc/osh/case/ostb1177.pdf

Cole, Ashley K,M.A., A.T.C., McGrath, Melanie L,PhD., A.T.C., Harrington, Shana E,PhD., M.P.T., Padua, Darin A,PhD., A.T.C., Rucinski, Terri J, MA, PT,A.T.C., C.S.C.S., & Prentice, William E, PhD, PT,A.T.C., F.N.A.T.A. (2013). Scapular bracing and alteration of posture and muscle activity in overhead athletes with poor posture. *Journal of Athletic Training, 48*(1), 12-24. Retrieved from http://search.proquest.com/docview/1368210825?accountid=14771

Cools, A.M., Witvrouw, E.E., Danneels, L.A., Cambier, D.C. (2002). Does taping influence electromyographic muscle activity in the scapular rotators in healthy shoulders? *Manual Therapy*. 7(3):154-162.

Davis, C.M. (2009). Complementary therapies in rehabilitation: evidence for efficacy in therapy, prevention, and wellness. Slack Inc, USA

Dembosky, A. (2013). Pregnancy apps raise fresh privacy concerns. *FT.Com,* Retrieved from http://search.proquest.com/docview/1446751142?accountid=14771

Dworkin, B., Miller, N.E., Dworkin, S., Birbaumer, N., Brines, M.L.,Jonas, S., Schwentker, E.P., Graham, J.J. (1985) Behavioral methodfor the treatment of idiopathic scoliosis. *Proc Nat Acad Sci* USA82(8):2493–2497

Edmond, L., Gabrielle, C., Hill, D., Wong, M.S. (2012). Development of a smart garment to reduce kyphosis during daily living. *Medical & Biological Engineering & Computing* November 2012, Volume 50, Issue 11, pp 1147-1154

Fu, F.H., Harner, C.D., & Klein, A.H. (1991). Shoulder impingement syndrome: a critical review. *Clinical Orthopedic Relative Resp*. 269:162-173.

Greenfield, B., Catlin, P.A., Coats, P.W., Green, E., McDonald, J.J., North, C. (1995). Posture in patients with shoulder overuse injuries and healthy individuals. *Journal Orthopedic Sports Physical Therapy*. 21(5):287-295.

Griegel-Morris, P., Larson, K., Mueller-Klaus, K., Oatis, C.A,. (1992) Incidence of common postural abnormalities in the cervical, shoulder, and thoracic regions and their association with pain in two age groups of healthy subjects. *Physical Therapy*. 72(6):425-431.

Heidegger, M. (1977). The question concerning technology, and other essays.

Hsu, Y.H., Chen, W.Y., Lin, H.C., Wang, W.T., Shih, Y.F. (2009). The effects of taping on scapular kinematics and muscle performance in baseball players with shoulder impingement syndrome. *Journal Electromyography Kinesiology*. 19(6):1092-1099.

Kibler, W.B., McMullen, J,. (2003). Scapular dyskinesis and its relation to shoulder pain. *Journal American Academic Orthopaedic Surgery*. 11(2):142-151.

Lewis, J.S., Green, A., Wright, C. (2005). Subacromial impingement syndrome: the role of posture and muscle imbalance. *Journal of Shoulder Elbow Surgery*. 14(4):385-392.

Lewis, J.S, Wright. C., Green., A. (2005). Subacromial impingement syndrome: the effect of changing posture on shoulder range of movement. *Journal of Orthopedic Sports Physical Therapy*. 35(2):72-87.

Lou, E., Lam, G. C., Hill, D. L., & Wong, M. S. (2012). Development of a smart garment to reduce kyphosis during daily living. *Medical & biological engineering & computing*, *50*(11), 1147-1154.

Lovell, W.W., Winter, R.B., Morrissy, R.T., Weinstein, S.L. (2006). Lovell and Winter's Pediatric orthopaedics, 6th edition, vol 2.Lippincott Williams & Wilkins, USA, p 7998

Ludewig, P.M., Cook, T.M., Nawoczenski, D.A. (1996). Three-dimensional scapular orientation and muscle activity at selected positions of humeral elevation. *Journal Orthopedic Sports Physical Therapy*. 4(2):57-65.

Ludewig, P.M., Cook, T.M,. (2000). Alterations in shoulder kinematics and associated muscle activity in people with symptoms of shoulder impingement. *Physical Therapy*. 80(3):276-291.

Macagno, A,E., O'Brien, M.F. (2006). Thoracic and thoracolumbar kyphosis in adults. *Spine* 31(19):S161–S170

Michener, L.A., McClure, P.W., Karduna, A.R,. (2003). Anatomical and biomechanical mechanisms of subacromial impingement syndrome. *Clinical Biomechanics* (Bristol, Avon). 18(5):369-379.

Miller, P., Osmotherly, P. (2009). Does scapula taping facilitate recovery for shoulder impingement symptoms? A pilot randomized controlled trial. *Journal Manual Therapy*. 17(1):E6-E13.

National Institute for Occupational Safety and Health. (2007). Ergonomic guidelines for manual material handling. DHHS Publication No. 2007-131. Washington, DC: US. Department of Health and Human Services, Centers for Disease Control and Prevention, NIOSH,.

Selkowitz, D.M., Chaney, C., Stuckey, S.J., Vlad, G. (2003). The effects of scapular taping on the surface electromyographic signal amplitude of shoulder girdle muscles during upper extremity elevation in individuals with suspected shoulder impingement syndrome. *Journal Orthopedic Sports Physical Therapy*. 37(11):694-702.

Sinett, T., Sinett, S. (2008) The truth about back pain: a revolutionary, individualized approach to diagnosing and healing back pain, 1st edn. *Penguin Group*, New York

Taylor, A. (Ed.). (2009). *Examined life: Excursions with contemporary thinkers*. The New Press.

Thigpen, C.A., Padua, D.A., Michener, L.A., et al. (2010). Head and shoulder posture affect scapular mechanics and muscle activity in overhead tasks. *Journal Electromyographic Kinesiology*. 20(4):701-709.

Uhl, T.L., Kibler, W.B., Tripp, B.L., Spigelman, T.H., McClelland, R.I. (2006). Effects of S3 brace on scapular resting position and kinematics. Paper presented at: Annual Meeting of *the American Orthopaedic Society for Sports Medicine*; June 29-July 2, Hershey, PA.

Uhl, T.L., Kibler, W.B., Tripp, B.L., Spigelman, T.H., McClelland, R.I. (2005). The effectiveness of a scapular brace on scapular kinematics. Paper presented at: *Annual Conference of the Society of Shoulder and Elbow Therapists*; November 9-12, Palm Beach, FL.

Ulkar, B., Kunduracioglu, B., Cetin, C., Guner, R.S. (2004) Effect of positioning and bracing on passive position sense of shoulder joint. *Journal Sports Medicine.* 38(5):549-552.

Walther, M., Werner, A., Stahlschmidt, T., Woelfel, R., Gohlke, F. (2004). The subacromial impingement syndrome of the shoulder treated by conventional physiotherapy, self-training, and a shoulder brace: results of a prospective, randomized study. *Journal Shoulder Elbow Surgery.*13(4):417-423.

Weon, J.H., Oh, J.S., Cynn, H.S., Kim, Y.W., Kwon, O.Y., Yi, C.H,. (2010). Influence of forward head posture on scapular upward rotators during isometric shoulder flexion. *Journal Body Movement Therapy*. 14(4):367-374.

Wheatley, E. (2005). Disciplining bodies at risk: Cardiac Rehabilitation and the Medicalization of Fitness. *Journal of Sport and Social Issues 29*(2),198-221.

Wong WY, Wong MS (2008) Smart garment for trunk posturemonitoring: a preliminary study. Scoliosis 3(7):1748–1761

Young, P. (2000). Ergonomic influences. *Office World News, 28*(12), 1-1,14+. Retrieved from http://search.proquest.com/docview/214930196?accountid=14771